ACP Chem. 1st Semester Final Exam 2016 KEY

1. $P_1 V_1 = P_2 V_2$

$P_1 = \cancel{3.33L}$ 2.23 atm

$V_1 = 3.33L$

$P_2 = 2.50 atm$

$V_2 = ?$

$$V_2 = \frac{P_1 V_1}{P_2} = \frac{(2.33 atm)(3.33L)}{(2.50 atm)}$$

$$= 2.97L \quad C$$

2. $PV = nRT$

$$P = \frac{n_T RT}{V} = \frac{(0.127 mol + 0.285 mol)\left(0.08205 \frac{L\text{-}atm}{mol\text{-}K}\right)(20+273K)}{6.00L}$$

$$= 1.66 atm \quad D$$

3. $PV = nRT$

$n = \frac{g}{m}$, $d = \frac{g}{V}$

$PV = \frac{gRT}{m}$, $\frac{g}{V} = \frac{PM}{RT}$, $\frac{P}{RT} = \frac{0.987 atm}{\left(0.08205 \frac{L\text{-}atm}{mol\text{-}K}\right)(273+7K)}$

$= 0.0401$

$1.37 g/L = (0.0401)x$

$\frac{1.37 g/L}{0.0401} = x = 34.16 g/mol$ C

4. $\frac{V_1}{T_1} = \frac{V_2}{T_2}$, $V_2 = V_1 \times \frac{T_2}{T_1} = 10.0L \times \frac{394}{298}$

$= 13.2L$ C

$V_1 = 10.0L$

$T_1 = 25 + 273K = 298K$

$V_2 = ?$

$T_2 = 121 + 273 = 394K$

5. $? \text{ mol } O_2 = 60.25 \text{ g KH} \times \frac{1 \text{ mol KH}}{40.02 \text{ g KH}} \times \frac{1 \text{ mol } O_2}{2 \text{ mol KH}} = 0.753 \text{ mol } O_2$

K = 39.10
H = 1.01
40.02

$PV = nRT$

$V = \frac{nRT}{P} = \frac{(0.753 \text{ mol})(0.08205 \frac{\text{L-atm}}{\text{mol-K}})(25+273 \text{K})}{1.00 \text{ atm}}$

$= 18.4$ B

6. $PV = nRT$

$n = \frac{PV}{RT} = \frac{(7.53 \text{ atm})(10.0 \text{ L})}{(0.08205 \frac{\text{L-atm}}{\text{mol-K}})(485 \text{K})} = 1.89 \text{ mol}$

$? \text{ molecules} = 1.89 \text{ mol} \times \frac{6.022 \times 10^{23} \text{ molecules } CO_2}{\text{mol } CO_2}$

$= 1.14 \times 10^{24}$ molecules CO_2 D

7. $\frac{V_1}{T_1} = \frac{V_2}{T_2}$, $T_2 = \frac{V_2}{V_1} T_1 = \frac{135 \text{ mL}}{350. \text{ mL}} \times 298 \text{K}$

$V_1 = 350. \text{ mL}$
$T_1 = 25+273 = 298 \text{K}$
$V_2 = 135 \text{ mL}$
$T_2 = ?$

$T_2 = 115 \text{K}$
or $115 - 273$
$= -158^\circ C$ C

8. $P_{Ne} = P_T - P_{Ar}$, $n_{Ar} = \frac{10 \text{ g}}{39.95 \text{ g/mol}} = 0.250 \text{ mol Ar}$

$P_{Ne} = P_T \frac{n_{Ne}}{n_T}$ $n_{Ne} = \frac{10.0 \text{ g}}{20.18 \text{ g/mol}} = 0.496 \text{ mol Ne}$

$= 1.6 \text{ atm} \left(\frac{0.250}{0.746}\right)$ $n_T = 0.746$

$= 1.06$ atm B

9. $X_{He} = 1 - (0.47 + 0.23) = 0.30$

$P_{He} = X_{He} P_T = (0.30)(7.85\,atm) = 2.36\,atm$ E

=

10. $PV = nRT$

$n_{F_2} = \frac{PV}{RT} = \frac{(2.60\,atm)(12.9\,L)}{(0.08205\,\frac{L\text{-}atm}{mol\text{-}K})(298K)} = 1.37\,mol\,F_2$

$?\,molecules\,XeF_6 = 1.37\,mol\,F_2 \times \frac{1\,mol\,XeF_6}{3\,mol\,F_2} \times \frac{6.022\times10^{23}\,molecules\,F_6}{1\,mole\,XeF_6}$

$= 2.75\times10^{23}\,molecules\,XeF_6$ D

11. ~~$? - g\ C_6H_6$~~

$?\,mL\,C_6H_6 = 1.5\times10^{3}\,kJ \times \frac{2\,mol\,C_6H_6}{6275\,kJ} \times \frac{78.11\,g\,C_6H_6}{1\,mol\,C_6H_6} \times \frac{mL}{0.88\,g}$

$= 42.4\,mL\,C_6H_6$ D

12. $\Delta E = w + q = $ ~~$-45\,kJ$~~ $-855\,J + -45\,kJ$

$= -45.86\,kJ$ A

13. J/°C B

14. $q = mS\Delta T$

$\Delta T = \frac{q}{mS}$, Smallest S yields greatest value for ΔT → Au B

15. $q = mS\Delta T$

$-4.85\,kJ = (376g)(0.128\,J/g°C)\Delta T$

$\Delta T = \frac{-4.85\,kJ}{(376g)(0.128\,J/g°C)} = -100.8°C$

$T_f = \Delta T + T_i = -100.8 + 398K = 297K$ E

16. $q_{cal} = C_{cal}\,\Delta T = -q_{rxn}$

$= (4.90\ kJ/^{\circ}C)(29.00 - 25.00^{\circ}C)$

$q_{cal} = 19.6$, $q_{rxn} = -19.6\ kJ$

$\Delta E = \dfrac{-19.6\ kJ}{mol\ sugar} = \dfrac{-19.6\ kJ}{0.0102\ mol} = -1922\ kJ$

B

$mol\ sugar = \dfrac{3.50\ g}{342.3\ g/mol} = 0.0102\ mol$

17. $w = 0$, ΔH & ΔE are positive C

18. $?\ kJ = 55.0\ kg\ Fe_3O_4 \times \dfrac{mol\ Fe_3O_4}{231.55\ g\ Fe_3O_4} \times \dfrac{1118\ kJ}{1\ mol\ Fe_3O_4}$

$= 265558\ kJ$ or $2.66 \times 10^5\ kJ$ B

19. $?\ mol\ O_2 = 100.0\ g\ octane \times \dfrac{1\ mol\ Octane}{114.33\ g\ octane} \times \dfrac{25\ mol\ O_2}{2\ mol\ octane}$

$= 10.9\ mol\ O_2$ A

20. E

21. $q_{H_2O} = m\,S\,\Delta T = -q_{rxn}$

$m = V_T \times 1.00\ g/mL = 200.0\ mL \times 1.00\ g/mL = 200.0\ g$

$q = (200.0\ g)(4.184\ J/g\,^{\circ}C)(37.00 - 35.00)$

$q = 1673.6\ J$

$q_{rxn} = -1673.6\ J$

$\Delta H = q_{rxn}/mol\ NaOH = \dfrac{-1673.6\ J}{0.03} = -55.8\ kJ/mol$

~~5.5×10~~

$mol\ NaOH = 0.300\ mol/L \times 0.1000\ L = 0.03$ A

22. $2S(s) + 2O_2(g) \rightarrow 2SO_2(g)$ $2(-296.8\,kJ)$

$2SO_2(g) + O_2(g) \rightarrow 2SO_3(g)$ $-197.8\,kJ$

$2S(s) + 3O_2(g) \rightarrow 2SO_3(g)$ $\Delta H_{rxn} = -791.4\,kJ$

A

23. D Std. heats of formation involve formation from elements in natural state.

24. $\Delta H^\circ_{rxn} = [\Delta H^\circ_f\, CHCl_3(\ell) + 3\Delta H^\circ_f\, HCl] - [\Delta H^\circ_f CH_4 + 3\Delta H^\circ_f Cl_2]$

$= [-134 + 3(-92)] - [-75]$

$= -335\,kJ$ C

25. B system does work, w is neg., loses heat q is neg

26. E more orderly structure in solid state

27. B more molecules of gaseous products than reactants

28. B endothermic process, ΔH_{sur} is neg.

29. A more structure in system, ΔS_{univ} is +

30. $\Delta G = \Delta H - T\Delta S$

$-$ $-$ non at high T

A

31. loses heat, ΔH is $-$, more orderly, ΔS is $-$

D

32. $\Delta G = \Delta H - T\Delta S$

$0 = \Delta H - T\Delta S = -11000J + T\ 17.4J/K$

~~$\frac{\Delta H}{\Delta S} = T = \frac{-11.0kJ}{-0.0174kJ/K}$~~ $\frac{11,000J}{17.4J/K} = T$

$T = 632K$ C

33. D molecules have greater entropy than atoms

34. E larger molar mass elements have greater entropy

35. D larger ionic compounds have greater entropy when dissolved in water

36. $\Delta S^\circ_{rxn} = (229.2) - [200.9 + 2(130.7)]$

$= 229.2 - 462.3$

$= -233.1\ J/K$ D

37. $3[N_2O(g) + NO_2(g) \rightarrow 3NO(g)]$ $3(-23.0kJ)$

$\Delta G^\circ_{rxn} = -69.0kJ$ B

38. Assume std conditions given ΔH°, ΔS° given,

So $T = 25^\circ C$ or $298K$

$\Delta G^\circ = 179.2kJ - (298K)(160.2J/K)$

$= 131.4\ kJ$ E

39. $NO(g) + O_3(g) \rightarrow NO_2(g) + O_2(g)$ $-199.5kJ$

~~$H_2(O_2$~~

$\frac{1}{2}[2O(g) \rightarrow O_2(g)]$ $\frac{1}{2}(-463.4kJ)$

$O(g) \rightarrow \frac{1}{2}O_2(g)$ -231.7

$\frac{1}{2}[3O_2(g) \rightarrow 2O_3(g)]$ $\frac{1}{2}(-489.6kJ)$

$\frac{3}{2}O_2(g) \rightarrow O_3(g)$ -244.8

$NO(g) + O(g) \rightarrow NO_2(g)$ $\Delta G^\circ_{rxn} = -676\ kJ$

E

40. A reversible reaction achieves theoretical limit with respect to free energy